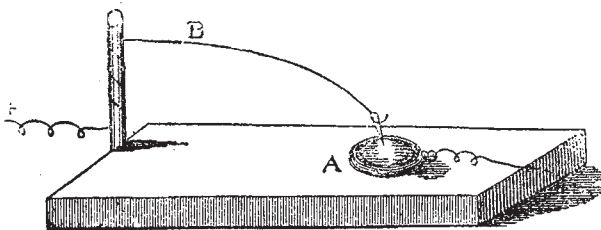


paper ribbon. The length of paper corresponding to an hour of time being known, it is easy to determine the instant at which the mark has been made, viz., the instant at which the shock has occurred.

Without any doubt the most interesting article in last year's *Bulletino* is that on the application of the microphone to the study of subterranean meteorology, by Prof. Michele de Rossi. In 1875 Count C. Mocenigo, of Vicenza, made an observation which was nothing less than the fundamental fact of the microphone, at a time when neither microphone, phonograph, nor micro-tasimeter had been invented. He observed that electric currents indicate perturbations and interruptions in a galvanometer by means of frictions and shocks produced artificially between conductors not in perfect contact ("per effetto soltanto di attriti e di scosse communicate artificialmente ai conduttori posti fra loro in semplice contatto instabile"). He also observed that the same phenomena were produced by natural and unknown causes, when the apparatus had not received any artificial shock. The account which he gave of his observations led Prof. de Rossi to conclude that these unknown perturbations arose from microseismic oscillations of the soil. He communicated his views to Count Mocenigo, who at once commenced to make experiments in the direction indicated, in the midst of which the news of the invention of the microphone in America, was received. Prof. de Rossi at once endeavoured to apply it to the detection of subterranean phenomena, and for this purpose he commenced a series of experiments in the seismic observatory which he has established at Rocca di Papa, one of the Alban Hills about seventeen miles from Rome. A special microphone consisting of a balanced pointed lever lightly touching a plate of silver, was mounted on a stone pedestal, and was placed twenty metres underground, at a distance from habitations and from roads. It was also thoroughly isolated and shut up in a box filled with wool. The instrument was watched during some of the stillest hours of the night, and the same mysterious sounds which Count Mocenigo had recognised were heard by de Rossi, which he considers were incontestably natural and intra-telluric. The sounds were carefully analysed, and were compared with artificially produced sounds. The microseismic sounds were speedily differentiated from other sounds, and their nature was completely confirmed when it was observed that they were often coincident with movements of the seismograph, and that they were of a periodic character. On one occasion, as de Rossi was listening at about half-past three o'clock in the morning the telephone connected with his subterranean microphone emitted sounds like the discharge of musketry, of such loudness that he feared they would awaken a child who slept in the same room, and he therefore disconnected the telephone. A short time afterwards, towards four o'clock, a sensible shock of earthquake occurred, for which the sounds had been the microphonic preparation.

In the beginning of last September Vesuvius showed many signs of an approaching eruption. During the night of the 22nd of that month the mountain produced thundering sounds, and at the same time loud metallic noises were heard in the microphone, more than a hundred miles distant. The microphone was soon afterwards transported to the observatory on Vesuvius, and it was then possible to trace the precise correspondence between the movements of the seismographs and the sounds of the microphone, and moreover to ascertain the seismic value (*il significato sismico*) of the different sounds of the microphone. It was also ascertained that if a watch were connected with the microphone, the noise of the tic-tac heard in the telephone became much louder just before a shock, and gradually less and less loud as the seismic

agitation died away. This led Prof. de Rossi to improvise a microphone which he has found very useful for microseismic purposes.



A watch, A, is placed upon a suitable stand, and a thin copper wire, B, connected with the positive pole of a small battery is arranged, as shown in the figure, so that one end of it, furnished with a steel needle, rests lightly upon the smooth silver surface of the watch. The handle of the watch is connected by the wire with the telephone, the other binding screw of which is connected with the negative pole of the battery. Such an arrangement furnishes a very effective microphone, if the degree of contact between the needle and the surface of the watch be carefully regulated.

G. F. RODWELL

### OUR ASTRONOMICAL COLUMN

THE OCCULTATION OF ANTARES, JULY 28.—The only occultation of a very conspicuous star during the present year which is visible in this country and in fact the only one higher than the second magnitude up to the year 1883, is that of Antares on the evening of July 28. It will take place at a low altitude here. As is well known Antares is a double star, and the effect of the duplicity was shown by observation of the occultation of the star by the moon, before the companion was detected by Mitchel at Cincinnati in July, 1845. The appearance of a comparatively faint star at emersion, suddenly brightening up to the full brilliancy of Antares, had been recorded, and a suspicion of duplicity entertained at least in one instance, some twenty years previous. Interest therefore attaches to the occultation of July 28, and with the view to facilitate the determination of the times of immersion or emersion at any place in this country, we will apply the Littrow-Woolhouse method of distributing the prediction of the phenomenon. Direct calculations give the following results for Greenwich, Edinburgh, and Dublin; the moon's place is corrected nearly to agree with Newcomb's theory:—

|            | Greenwich M.T.<br>of Immersion. | Angle from<br>N. Point. | Greenwich M.T.<br>of Emersion. | Angle from<br>N. Point. |
|------------|---------------------------------|-------------------------|--------------------------------|-------------------------|
|            | h. m.                           |                         | h. m.                          |                         |
| Greenwich. | 9 38'11 ...                     | 153'3                   | 10 7'03 ...                    | 200'2                   |
| Edinburgh. | 9 38'53 ...                     | 166'5                   | 9 49'93 ...                    | 184'9                   |
| Dublin ... | 9 33'05 ...                     | 161'4                   | 9 50'53 ...                    | 189'0                   |

From which, putting the latitude of the place =  $50^{\circ} + L$  ( $L$  in degrees), and the longitude in minutes of time =  $M$  (+ if east, - if west of Greenwich), we find—

$$\begin{aligned} \text{G.M.T. of Immersion} &= 9\ 36'86 + 0'841 L + 0'263 M \\ \text{Emersion} &= 10\ 10'74 - 2'507 L + 0'462 M \end{aligned}$$

$$\begin{aligned} \text{Angle from N. Point at Immersion} &= 149'4 + 2'6 L - 0'1 M \\ \text{Emersion} &= 204'2 - 2'7 L + 0'2 M \end{aligned}$$

These formulæ give for—

|               | Immersion. | Angle. | Emersion.  | Angle. |
|---------------|------------|--------|------------|--------|
|               | h. m.      |        | h. m.      |        |
| Cambridge ... | 9 38'7 ... | 155    | 10 5'2 ... | 198    |
| Oxford ...    | 9 37'0 ... | 155    | 10 4'0 ... | 198    |
| Liverpool ... | 9 36'5 ... | 160    | 9 56'5 ... | 192    |

Which are Greenwich mean times: the angles are reckoned as is usual in the occultation-predictions of the *Nautical Almanac*, for the inverted image. At Greenwich

\* "Fenomeni singolari di interferenza fra le correnti elettriche ed i promossi meccanicamente sul legno."—Bassano, 1875.

the altitude of the star at emersion will be  $7\frac{1}{2}^\circ$ , and at Edinburgh  $5\frac{1}{2}^\circ$ .

Suppose, for the sake of an example of the application of the above formulæ, it is desired to know the Greenwich mean times of immersion and emersion of Antares as viewed from Brighton, which place we will assume to be in latitude  $50^\circ 50'$  and longitude  $0^m. 32^s$ . west of Greenwich. We have then  $L = +0^\circ 83'$ , and  $M = -0^\circ 53'm$ ; it will be sufficient to include the second decimal only in the factors for L and M in the formulæ:—

For the immersion—

$$\begin{aligned} (+0^\circ 83') \times (+0^\circ 84') &= +0^\circ 70' \\ (-0^\circ 53') \times (+0^\circ 26') &= -0^\circ 14' \end{aligned}$$

The sum  $+0^\circ 56'm$ , added to  $9h. 36^\circ 86'm$ , gives  $9h. 37^\circ 4m$ . for G.M.T.

For the emersion—

$$\begin{aligned} (+0^\circ 83') \times (-2^\circ 51') &= -2^\circ 08' \\ (-0^\circ 53') \times (+0^\circ 46') &= -0^\circ 24' \end{aligned}$$

The sum  $-2^\circ 32'm$ , added to  $10h. 10^\circ 74'm$ , gives  $10h. 8^\circ 4m$ . for G.M.T.

Similarly the angles will be found to be  $152^\circ$  at immersion and  $202^\circ$  at emersion.

The companion of Antares preceding the principal star nearly on the parallel will emerge several seconds earlier.

THE GREAT COMET OF 1874.—Just five years since, as we write, the comet discovered by M. Coggia at the Observatory of Marseilles on April 17, 1874, was beginning to attract general attention as a naked-eye object in the evening sky. The orbit, the determination of which presented some difficulty at first, from the slow motion of the comet, had been ascertained with sufficient precision to enable astronomers to predict its conspicuous appearance in the first half of July, and the track it would follow when, descending below the horizon in Europe, it became a favourably-situated object for the observatories of the other hemisphere. It was observed in Europe until July 16, and about a week later was seen in Australia; observations were continued till October, the last being made at the Argentine Observatory, Cordoba, on the 18th of that month, when it had receded to a distance of  $1.94$  from the sun and  $1.79$  from the earth, and was situate about  $12^\circ$  from the south pole of the heavens.

The European observations during three months were found to indicate a sensible, though not very material deviation of the orbit from a parabola, and ellipses were calculated at the time by Tietjen, Schulhof, and Geelmuyden. In a late number of the *Astronomische Nachrichten* are elliptical elements founded by M. Seyboth, of Riga, upon the meridian observations made at Moscow, which appear to possess a very high degree of precision, though they extend over an interval of twenty-six days only. The periods of revolution assigned by these computers are:—

|                   |              |
|-------------------|--------------|
| Tietjen ... ..    | 8,965 years. |
| Schulhof ... ..   | 12,184 "     |
| Geelmuyden ... .. | 10,445 "     |
| Seyboth ... ..    | 5,711 "      |

The differences between these periods show that beyond establishing the fact that the comet was moving in an orbit with a period of revolution extending to several thousand years, no reliable approximation to its true length has yet been obtained, but the additional three months' observations in the southern hemisphere have not hitherto been brought to bear upon the determination of the elements. The last Cordoba observations give the following final position:—

1874, October 18, at  $14h. 46m. 58s.$  G.M.T.

|                                 |                      |
|---------------------------------|----------------------|
| Apparent Right Ascension ... .. | $99^\circ 46' 27''$  |
| " Declination ... ..            | $-77^\circ 42' 36''$ |

If we compare the elements of Geelmuyden and Seyboth with this observation, taking aberration into account, we find the following differences:—

Error in R.A.

Error in Decl.

|                   |        |        |
|-------------------|--------|--------|
| Geelmuyden ... .. | $+3''$ | $+65'$ |
| Seyboth ... ..    | $+59'$ | $+99'$ |

so that while, as tested by this single observation, the longer period of revolution appears to have the advantage, it is sufficiently evident that ellipses with divergent periods may eventually be found to represent the observations with almost equal precision; or in other words the length of the revolution will remain open to considerable uncertainty. If the deviation of the form of the orbit from the parabola, which satisfies the motions of the majority of comets be due to planetary attraction, we might look to Venus as the agent, since at the descending node the comet in 1874 approached the orbit of that planet within 300,000 miles ( $0.00325$  of the earth's mean distance); the opposite node falls at a radius-vector of  $11.65$ . The aphelion distance, according to Geelmuyden's calculation would be  $955^\circ$ , or the comet would have travelled to these parts of space from a distance exceeding by more than thirty times the mean distance of Neptune.

### GEOGRAPHICAL NOTES

THE Abbé Debaize, who by previous accounts was at Igonda on March 20, seven days' journey from Ujiji, has written under date of April 2 from the latter place to the director of the Paris Observatory and others, giving a brief sketch of his immediate plans. He proposes to take all his porters and merchandise by water to the Uzighé country at the north end of Lake Tanganyika, and to form a dépôt there, which he will leave in charge of some of his best men; he will then establish a second dépôt at the mouth of the Aruwimi, the great northern tributary of the Congo. Afterwards, starting in light marching order, he hopes to be able to explore the western slopes of the Blue Mountains, the countries situated between the southern end of Albert Nyanza and Lake Tanganyika, and especially Unyambongu, Mpororo, and Ruanda. He will then return to his dépôt in Uzighé, whence he will send home an account of his discoveries, as well as a statement of his future plans.

AN interesting and extremely well written pamphlet has just appeared in the "Sammlung gemeinverständlicher wissenschaftlicher Vorträge," edited by Prof. Virchow and Herr von Holtendorff. Its title is "Die Tiefsee und ihre Boden- und Temperatur Verhältnisse," its author Dr. Georg von Boguslawski, the well-known editor of the *Annalen der Hydrographie* at the Imperial Admiralty of Berlin. The writer first gives a clear and concise account of all expeditions sent out by various countries for the investigation of the depths of the sea, particularly those of the *Gazelle*, the *Challenger*, and the *Tuscarora*. He then enters at greater length upon a discussion of the results obtained hitherto, treating first of the depths themselves, then of the outlines and physical condition of the sea-bottom, and finally of the distribution of temperatures and the inter-oceanic currents, with their causes and effects. Our space does not permit us to enter into details at greater length, suffice it to say that the little work is a welcome and valuable addition to scientific literature.

THE Geographical Department of the Japanese Government, which is displaying considerable activity in many directions, has commenced the publication in sheets of a large plan of the city of Yedo, showing the various divisions, streets, bridges, &c., and giving the names in Japanese and Roman characters.

UNDER the title of "Voyage d'Exploration dans l'Intérieur des Guyanes," the *Tour du Monde* has commenced the publication of Dr. Jules Crevaux' account of his journey in 1876-7 through French Guiana and across the Tumac Humac range to the Amazons. The illustrations are very interesting and well executed, and there is also a sketch map of the region.